General Information:

Name: Oak Grove Slave Cemetery

Address: No physical site street address, Village of Alamance Mailing Address- PO Box 96 Alamance NC 27201

Location: Contained within the Heritage Glen Subdivision, at the corner of Yorkshire Dr., and Brookstone Dr.

Coordinates: 36.02483827920802, -79.49246031364069

Parcel ID: 172464

Area: Within the Village of Alamance incorporated limits.

Owner: Heritage Glen Homeowners Association, The Village of Alamance is in negotiation with the HOA to assume ownership.

Date: April 3, 2024

Contacts: Town Administrator, Nick Farmerie- 336-226-0033/ Mayor, Don Tichy- 336-269-4202

ABSTRACT PROPOSAL FOR DESIGNATION

The Oak Grove Slave Cemetery is the resting place for approximately 40 enslaved African Americans belonging to the 19th century Holt family. Descendants of the enslaved people who are buried in the cemetery have gone on to significantly affect the regional development of Alamance County and the surrounding areas. The deceased have a variety of life stories that have contributed to the national discourse about the struggle for civil rights.

The formerly enslaved peoples' accomplishments include establishing the Springdale A.M.E Church, establishing one of the first schools to train African American teachers in the community, helping with the development and dying the original Alamance Plaid design, being appointed as the County's first black deputy sheriff, and efforts to quell Ku Klux Klan activities in this area by giving testimony to the United States Senate. (see Vincent, 2009 pp. 35-6; 41-2; Troxler & Vincent, 1999, p.327)

We believe the significant accomplishments of the descendants of these slaves along with the overarching themes concerning slavery, reconstruction, and regional development must be preserved for future generations to gain insight as to how history has cultivated our current reality. Recognizing this site is the first step in preserving history to tell their stories.

The site, located at Parcell ID 172464, is part of the Heritage Glen Homeowners Association property. The Village of Alamance is in negotiation to acquire the parcel and is in the best position to maintain the site to preserve the historical elements located within.

Special care has been taken not to remove evergreen ornamental ground cover (Vinca minor, referred to as “cemetery vine”) that was commonly planted on top of graves during that period to honor those entombed along with the unmarked field stones that were typically used as headstones. The goal of the preservation work to date has been to maintain as much integrity at the site as to reflect the actual condition it was in, more than 100 years ago.

HISTORICAL BACKGROUND 3.1

The Oak Grove Slave Cemetery was part of the E.M. Holt family plantation and used as a repository for slaves that had passed while in the Holt family ownership. Most grave sites of enslaved African- Americans are abandoned, unmarked, and forgotten. In 1915 this land was sold to the Patterson Family and remained, undeveloped, until it was then purchased by Cornerstone Properties to build the Heritage Glen subdivision. On October 7th, 2014, the New South Associates published their Technical Report for the ground penetrating radar work to identify where grave sites are located. This land was then deeded to the Heritage Glen HOA. The Village of Alamance is in the process of acquiring ownership of the land.

HISTORIC BACKGROUND 3.2

The cemetery was used between 1790 and 1865.

HISTORIC BACKGROUND 3.3

A sewer main line was developed adjacent to the property in 1999 on the north west side to service the Heritage Glen subdivision. Construction of the Heritage Glen subdivision started in 1999 and the phase that started to break ground on land near the cemetery started between 2015 and 2021.

ASSESSMENT 1.1

This site memorializes the remains of slaves owned by the influential Holt family, headed by Edwin Michael Holt whose son, Tomas Holt, was elected Governor of North Carolina in 1891.

The relatives of the slaves buried in the cemetery have regional significance, including Sam Holt who founded the Springdale A.M.E church in 1865. Like many other slaves that were emancipated from slavery, Sam and other slaves, chose to take his master’s last name, Holt. In 1853 Sam Holt, along with his brother Caswell Holt also helped to dye the original ‘Alamance Plaid’ design which became the first commercially produced colored cotton fabric made in the America South. Caswell Holt also has the distinction of being the first black deputy sheriff in Alamance County and helped to quell Ku Klux Klan activities in the region. (see Beatty, 1999, pp. 114-16 & U.S. Congress, Senate Reports, 42 Cong. 1st session, no. 1, 341-2)

ASSESSMENT 1.2

The site is approximately six feet lower in elevation than the roadway that runs adjacent to the site. Currently the site is overgrown and easily missed. The only "structure" on the property is a small wooden sign that informally designates the site as the Oak Grove Slave Cemetery erected by a local Boy Scout Troop. The land is relatively flat with a small rock wall that separates the graves from the rest of the land. The land is sparsely wooded with small shrubs, ivy and grasses covering the ground. Behind the property is the sewer easement for the Village of Alamance.

ASSSESSMENT 1.3

There are raw quartz field stones placed over the known enslaved grave sites. As in the daily life of the entombed, the cemetery is a segregated resting place. Quartz rock was often used as grave markers as a type of memorial during the Antebellum period of the 19th century. Slave burial sites often lacked proper headstones or markers, leaving the memory of these individuals lost to history. The harsh conditions of slavery, systemic racism, and economic disparities meant that enslaved people were often denied the dignity of a marked grave. Their stories and contributions have been overlooked for generations.

There is a non-native type of ornamental ivy called Vinca Vines that is found growing over where suspected graves are located. In 2014 New South Associates conducted ground penetrating radar and identified fourteen "probable burials, all within the general vicinity of the area," along with three "potential faint depression sites."

ASSESSMENT 1.4

Integrity of Design:

The cemetery design exists in a similar condition as possible to what was originally established. There are no known photographs of the gravesite, so it is difficult to replicate the original with certainty. Consequently, we have preserved the site to what the regional norms were for burial during that time period.

Setting:

The surrounding area has been developed as the Heritage Glen residential subdivision. The gravesite parcel is only connected to two residentially developed pieces of property on its northern border. The rear side or northwestern part of this parcel is near a sewer easement for the Village of Alamance.

Workmanship:

No official memorial is currently established at this site. The Village is working with the Alamance County Historical Museum and our engineers to create a memorial site plan. Currently, there is a small wooden sign that identifies the Oak Grove Slave Cemetery.

ASSESSMENT 1.5

Our expectation is to have parcel ID 172464 designated as a historical site. We are hopeful to create a small parking area and a small memorial near the cemetery with a narrative that describes what this site is and how the descendants of these slaves affected the regional development of North Carolina.

DESIGNATION PARAMETERS

SUPPORTING DOCUMENTATION

Please see additional documents packet.

BIBLIOGRAPHY

Beatty, Bess. Alamance: the Holt Family and Industrialization in a North Carolina County, 1837 1900. Baton Rouge, Louisiana. Louisiana State University Press 1999.

Troxler, Carole W. and William M. Vincent. Shuttle and Plow: A History of Alamance County, North Carolina. Burlington, North Carolina. Alamance County Historical Association, Inc. 1999.

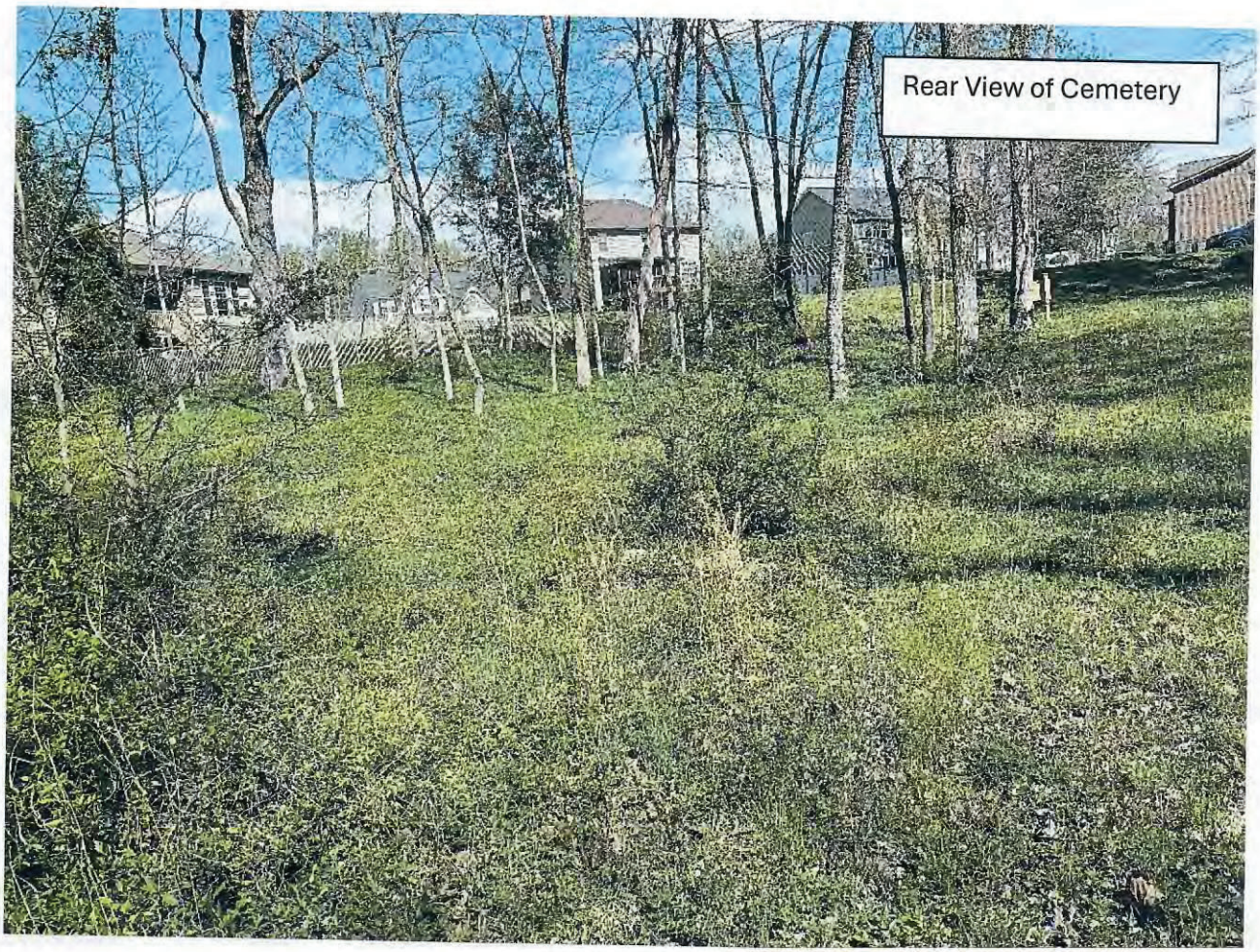
U.S. Congress, Senate Reports 42d Congress, 1st Session, no. 1.

Vincent, William Murry. Historical Alamance County: A Biographical History. San Antonio, Texas. Historical Publishing Network/ Lammert, 2009.

Southwestern View from Yorkshire Dr.

Northwestern View from Yorkshire Dr.

Close up image of the rock wall, sign and ivy



Rear View of Cemetery

Cemetery Identification Form
Alamance County, NC

If you are aware of a cemetery (family burial plot, Native American burial ground, etc.) in the county, please complete and return this form to:
Alamance County Planning Department at 217 College St Suite C, Graham NC 27253.

I. Applicant Contact Information

Name: Alamance County Historical Museum
Address: 4777 S NC Highway 62 Burlington, NC 27215
Phone Number: 226-8254 Email: achm@triad.twcbc.com

II. Cemetery Information

A. Name of cemetery: Oak Grove Plantation Slave Cemetery
B. Address/specific location: Parcel I.D # 111607 · South-west section - between 3105 Brookstone Drive and 3241 Brookstone Drive Burlington, NC 27215
C. Type (i.e. family, church, Native American): Slave Family
D. Status:

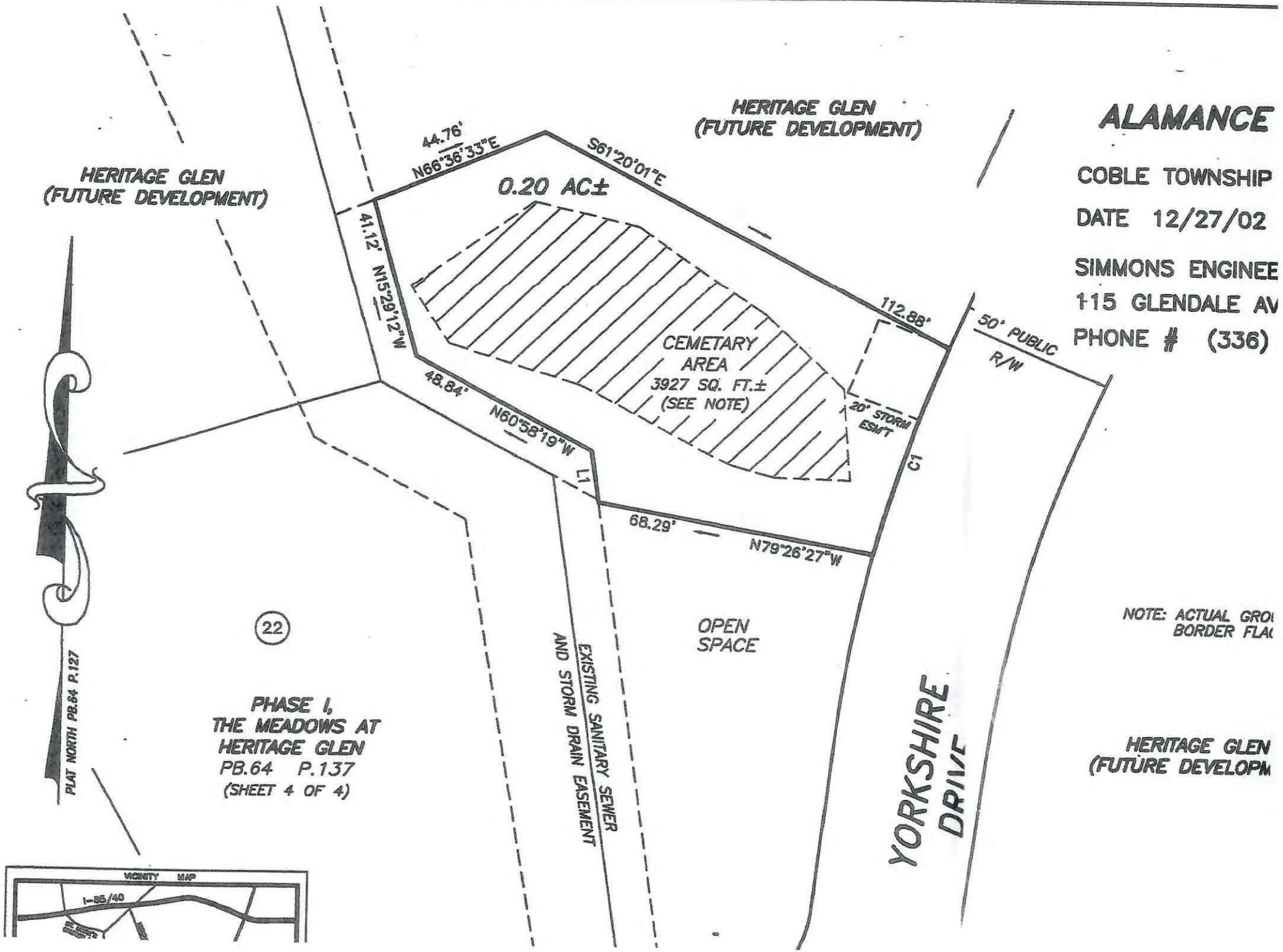
- ☑ Abandoned (overgrown/neglected)
- ☐ Maintained, but not used
- ☐ Currently in use

E. Approximate number of graves: ~~20~~ 40

III. History and/or Importance of Cemetery

The cemetery was used 1790-1865 by Slaves of Michael Holt's Oak Grove Plantation. Buried here are relatives of the Founders of Springdale AME Church, including Jim, Jude, Rose, Minerva, Madison, Lindsey, Joe, Hester and her three unnamed children, Sang, Ester, Charity, Phillip, Rhoda, Jinney, Dennis, Jordan, and two unnamed Children of Lotty.

If you have any questions regarding this form please contact:
Alamance County Planning Department
(336) 570-4053


HERITAGE GLEN
(FUTURE DEVELOPMENT)
HERITAGE GLEN
(FUTURE DEVELOPMENT)
44.76'
N66°36'33"E
S61°20'01"E
0.20 AC±
41.12'
N15°29'12"W
112.88'
50' PUBLIC
R/W
CEMETARY
AREA
3927 SQ. FT.±
(SEE NOTE)
20' STORM
ESMT
48.84'
N60°58'19"W
L1
C1
68.29'
N79°26'27"W
22
OPEN
SPACE
EXISTING SANITARY SEWER
AND STORM DRAIN EASEMENT
YORKSHIRE
DRIVE
PLAT NORTH PB.64 P.127
PHASE I,
THE MEADOWS AT
HERITAGE GLEN
PB.64 P.137
(SHEET 4 OF 4)
VICINITY MAP
I-85/40
ALAMANCE
COBLE TOWNSHIP
DATE 12/27/02
SIMMONS ENGINEE
115 GLENDALE AV
PHONE # (336)
NOTE: ACTUAL GRO
BORDER FLA
HERITAGE GLEN
(FUTURE DEVELOPM

Copy of Slave Ledger from Alamance Historical Museum

Jim (1845)
Jude
Rose (1838)
Minerva (1832)
Madison (1834)
Lindsey (1837)
Joe (1851)
Hester (1841) and 3 children
Samy
Ester
Charity
Phillip
Rhoda
Jinney
Dennis
Jordan
2 unnamed children of Lotty

Slave Cemetery

African-American cemetery used 1790-1865 by slaves of Michael Holt's Oak Grove Plantation. Buried here are relatives of the founders of Springdale A.M.E. Church, including Jim, Jude, Rose, Minerva, Madison, Lindsey, Joe, Hester and her three unnamed children, Samy, Ester, Charity, Phillip, Rhoda, Jinney, Dennis, Jordan, and two unnamed children of Lotty.

Slave Cemetery

African-American cemetery used 1790-1 by slaves of Michael Holt's Oak Grove Plant Buried here are ancestors of the found of Springdale A.M.E. Church.

Alamance County

March 27, 2024

1:600

0 0.005 0.01 0.02 mi

0 0.0075 0.015 0.03 km

Alamance County GIS

Address Points

- Address
- Tax Address
- Preliminary Address

Heavy Industrial Development Applicants

- APPLIED FOR PERMIT
- PERMIT APPROVED
- PERMIT RENEWED
- UNDER CONSTRUCTION

Value of Land:

Parcel ID 172464, assessed value- $11,500

Ground-Penetrating Radar Survey to Prospect for Burials within a Suspected Cemetery in the Heritage Glen Subdivision

Alamance County, North Carolina

New South Associates, Inc.

Ground-Penetrating Radar Survey to Prospect for Burials within a Suspected Cemetery in the Heritage Glen Subdivision

Alamance County, North Carolina

Report submitted to:

McPherson Grading Co. • 2641 Russell McPherson Road • Burlington, North Carolina 27215

Report prepared by:

New South Associates • 6150 East Ponce de Leon Avenue • Stone Mountain, Georgia 30083

and

New South Associates • 408B Blandwood Avenue • Greensboro, North Carolina 27401

Shawn M. Patch, M.A., RPA – Principal Investigator

Sarah Lowry – Archaeologist and Author

October 7, 2014• Final Report

New South Associates Technical Report 2424

ABSTRACT

New South Associates conducted a ground-penetrating radar (GPR) survey at an area suspected to contain an unmarked cemetery within the Heritage Glen subdivision in Alamance County, North Carolina. The suspected cemetery was identified through oral histories and the presence of isolated and non-native, ornamental vinca vines (sometimes referred to as "cemetery ivy") vegetation. New South personnel identified three potential faint depressions on site. The purpose of the survey was to identify unmarked burials and map cemetery boundaries in order to avoid construction disturbance. Sarah Lowry with assistance from Lauren Souther conducted fieldwork on September 2, 2014. The survey located 14 probable burials, all within the general vicinity of the area thought to have a cemetery. None of the probable burials have associated markers,.

New South Associates recommends that the 14 GPR anomalies identified as probable graves should be treated as such. This cemetery is suspected to date to the nineteenth century and to contain African American interments. Older remains and those from economically disadvantaged communities are particularly difficult to map with GPR. To ensure the cemetery is entirely avoided, it is recommended that a 20-foot buffer be drawn around the identified graves. These should be avoided by proposed construction impacts and identified as a cemetery. While there are no specific statutory requirements for a buffer around cemeteries, New South Associates recommends the use of a buffer to avoid impacts to burials on the edges of a cemetery that may not have been detected; these include the graves of infants and children. In our experience, especially with older graves, a 20-foot buffer provides extra consideration and protection for graves that may be difficult to detect with any remote method. If the buffer size is reduced, the project sponsor must do this at their own risk. If avoidance is not possible, then additional steps should be taken to relocate the burials in compliance with North Carolina General Statutes Chapter 65, Article 12, Sections 85-113, Abandoned and Neglected Cemeteries. In addition, the cemetery should be recorded formally with the Alamance County Courthouse so there is a record of its identification.

ACKNOWLEDGEMENTS

Kristin M. Foust from McPherson Grading Company provided valuable in field assistance. Additionally, Vincent C. Townsend of Green Mountain Engineering, PLLC mapped the recommended buffer area for the engineering plans.

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LIST OF FIGURES AND TABLE

I. INTRODUCTION

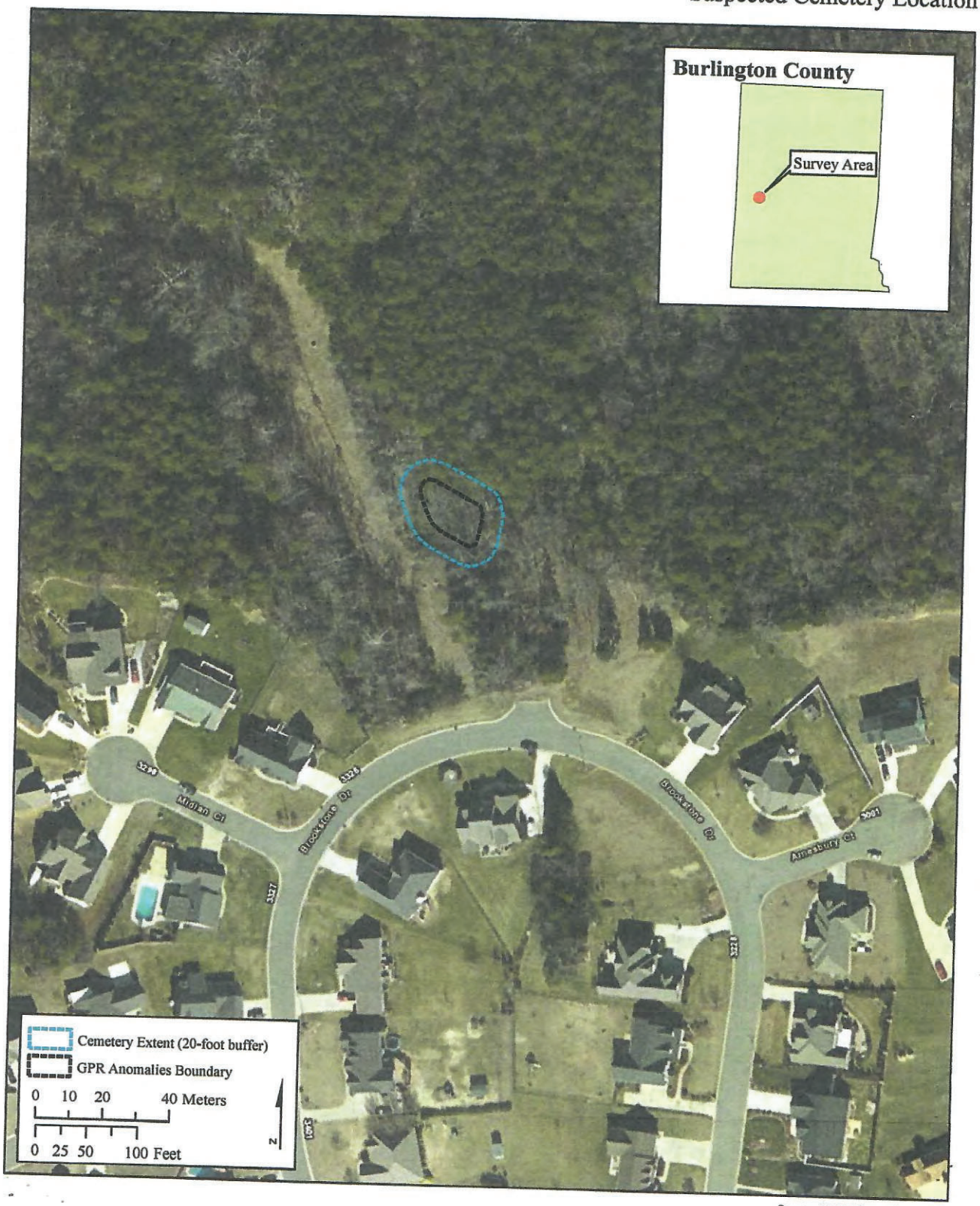
New South Associates, Inc., conducted a ground-penetrating radar (GPR) survey on an area suspected to be a cemetery located in the Heritage Glen subdivision, Alamance County, North Carolina (Figure 1). The purpose of the survey was to identify unmarked burials in order to determine the cemetery extent for future construction avoidance. This cemetery is suspected to date to the nineteenth century and to contain African American interments. It is located immediately adjacent to a drainage and is covered with non-native ornamental vegetation. Sarah Lowry and Lauren Souther conducted fieldwork on August 2, 2014.

The suspected cemetery is located in a wooded area north of Brookstone Drive where new development is planned. The ground disturbing activities are occurring on the land surrounding the cemetery and the GPR grid was placed to determine the extent of the cemetery.

Oral histories date this cemetery to the nineteenth century and suggest that it was an African American slave cemetery. No markers were present and the suspected cemetery is not identified on deed records. For these reasons, dates and ethnicity hypotheses cannot be verified. Vinca (sometimes referred to as "cemetery ivy"), which is a non-native plant often associated with historic cemeteries, covers the entire area. Three possible depressions were located within the ivy-covered area. The lack of markers in a cemetery is not unusual. Often times, they are moved, perishable materials degrade over time, and/or in economically disadvantaged communities markers are often made from impermanent materials such as concrete and wood. The interpreted results of the GPR survey identified 14 possible burials that are all within the general cemetery vicinity.

New South Associates recommends that the 14 GPR anomalies identified as possible graves should be treated as such. Older and more economically disadvantaged burials are often difficult to identify using GPR results so it is recommended that a buffer be drawn around the identified burials for avoidance during construction. While there are no specific statutory requirements for a buffer around cemeteries, New South Associates recommends the use of a buffer to avoid impacts to burials on the edges of a cemetery that may not have been detected; these include the graves of infants and children. In our experience, especially with older graves, a 20-foot buffer provides extra consideration and protection for graves that may be difficult to detect with any remote method. If the buffer size is reduced, the project sponsor must do this at their own risk. Ground disturbance should be avoided in the area of the identified burials and the 20-foot buffer. In the event that they cannot be avoided, provisions will need to be made for disinterment and

Figure 1.
Suspected Cemetery Location



Source: 2010 Microsoft Imagery

reburial in compliance with North Carolina General Statutes Chapter 65, Article 12,Sections 85-113, Abandoned and Neglected Cemeteries. In addition, the cemetery should be recorded formally with the Alamance County Courthouse so there is a record of its identification.

The suspected cemetery soils were moderately gullied land, Helena, Enon, and Wilkes materials (Mg) with 6-25 percent slopes (Kaster 1960). Data quality within the sandy loams was excellent. Several downed trees made it necessary to divide the survey area into two grids and ground access was limited in the areas within the center of the suspected cemetery. An adequate boundary survey was possible.

The report is divided into three chapters. Chapter I introduces the investigation and describes the project setting. Chapter II outlines the methods employed during the field investigations and Chapter III discusses the field investigation results and recommendations.

II. METHODS

SURVEY GRID

Prior to data collection, it was first necessary to establish a grid. This was accomplished using metric measuring tapes. Grid corners were placed in order to cover the center of the suspected cemetery and extend to the edge of the drainage to the southwest and cover the dense cemetery ivy in other directions. Survey flags were used to mark each grid corner. Grid corners were mapped using a Trimble GPS unit.

All data were downloaded from the Trimble GPS unit and then imported into ArcMap 10, ESRI's geographic information system (GIS) program. Separate shapefiles were then created for the geophysical interpretations and grids. The advantage of this method is that each feature now has associated coordinates and can be relocated.

GROUND PENETRATING RADAR (GPR)

GPR is a remote sensing technique frequently used by archaeologists to investigate a wide range of research questions. In archaeological applications, GPR is used to prospect for potential subsurface features. Because GPR is a remote sensing technique, it is non-invasive, non-destructive, relatively quick, efficient, and highly accurate when used in appropriate situations. In cemeteries, GPR is commonly used to identify anomalies consistent with the expectations for human graves (Jones 2008; King et al. 1993).

The use of GPR for identifying potential historic graves is based on the concept of contrast, which may include differences in physical, electrical, or chemical properties between an object or feature and its surrounding matrix (Conyers 2004b). For graves, the body itself is generally not detected; it is typically the coffin or casket, burial shaft, or bottom of the grave that causes the reflection (Jones 2008; King et al. 1993). Not surprisingly, greater contrast generally equates to better detection and resolution. For example, a metal casket in a concrete vault is much easier to see with GPR than a body buried in a wooden coffin only.

GPR data are acquired by transmitting pulses of radar energy into the ground from a surface antenna, reflecting the energy off buried objects, features, or bedding contacts, and then detecting the reflected waves back at the ground surface with a receiving antenna (Conyers 2004b:1). When collecting radar reflection data, surface radar antennas are moved along the ground in transects, typically within a surveyed grid, and a large number of subsurface reflections are collected along each line. As radar energy moves through various materials, the

velocity of the waves will change depending on the physical and chemical properties of the material through which they are traveling (Conyers and Lucius 1996). The greater the contrast in electrical and magnetic properties between two materials at an interface, the stronger the reflected signal, and, therefore, the greater the amplitude of reflected waves (Conyers 2004a).

When travel times of energy pulses are measured, and their velocity through the ground is known, distance (or depth in the ground) can be accurately measured (Conyers and Lucius 1996). Each time a radar pulse traverses a material with a different composition or water saturation, the velocity will change and a portion of the radar energy will reflect back to the surface and be recorded. The remaining energy will continue to pass into the ground to be further reflected, until it finally dissipates with depth.

The depths to which radar energy can penetrate, and the amount of resolution that can be expected in the subsurface, are partially controlled by the frequency (and therefore the wavelength) of the radar energy transmitted (Conyers 2004a). Standard GPR antennas propagate radar energy that varies in frequency from about 10 megahertz (MHz) to 1000 MHz. Low frequency antennas (10-120 MHz) generate long wavelength radar energy that can penetrate up to 50 meters in certain conditions but are capable of resolving only very large buried features. In contrast, the maximum depth of penetration of a 900 MHz antenna is about one meter or less in typical materials, but its generated reflections can resolve features with a maximum dimension of a few centimeters. A trade-off therefore exists between depth of penetration and subsurface resolution.

The success of GPR surveys in archaeology is largely dependent on soil and sediment mineralogy, ground moisture, subsurface material moisture retention, the depth of buried features, and surface topography and vegetation. Electrically conductive or highly magnetic materials will quickly attenuate radar energy and prevent its transmission to depth. Depth penetration varies considerably depending on local conditions. Subsurface materials that absorb and retain large amounts of water can effect GPR depth penetration because of their low relative dielectric permittivity (RDP). In practical applications, this generally results in shallower than normal depth penetration because the radar signal is absorbed (attenuated) by the materials regardless of antenna frequency (Conyers 2004b; 2012; Conyers and Lucius 1996). Differential water retention can also positively affect data when a material of interest, such as a burial, retains more water than the surrounding soils and, therefore, presents a greater contrast.

The basic configuration for a GPR survey consists of an antenna (with both a transmitter and receiver), a harness or cart, and a wheel for calibrating distance. The operator then pulls or pushes the antenna across the ground surface systematically (a grid) collecting data along transects. These data are then stored by the receiver and available for later processing.

The "time window" within which data were gathered was 40 nanoseconds (ns). This is the time during which the system is "listening" for returning reflections from within the ground. The greater the time window, the deeper the system can potentially record reflections. To convert time in nanoseconds to depth, it is necessary to determine the elapsed time it takes the radar energy to be transmitted, reflected, and recorded back at the surface by doing a velocity test. Hyperbolas were found on reflection profiles and measured to yield a relative dielectric permittivity (RDP), which is a way to calculate velocity. The shape of hyperbolas generated in programs is a function of the speed at which electromagnetic energy moves in the ground, and can therefore be used to calculate velocity (Conyers and Lucius 1996). The RDP for soils in the survey area was approximately 7.8, which, when converted to one-way travel time, (the time it takes the energy to reach a reflection source), is approximately 10 centimeters/nanosecond. All profiles and processed maps were converted from time in nanoseconds (ns) to depth in centimeters using this average velocity.

FIELD METHODS

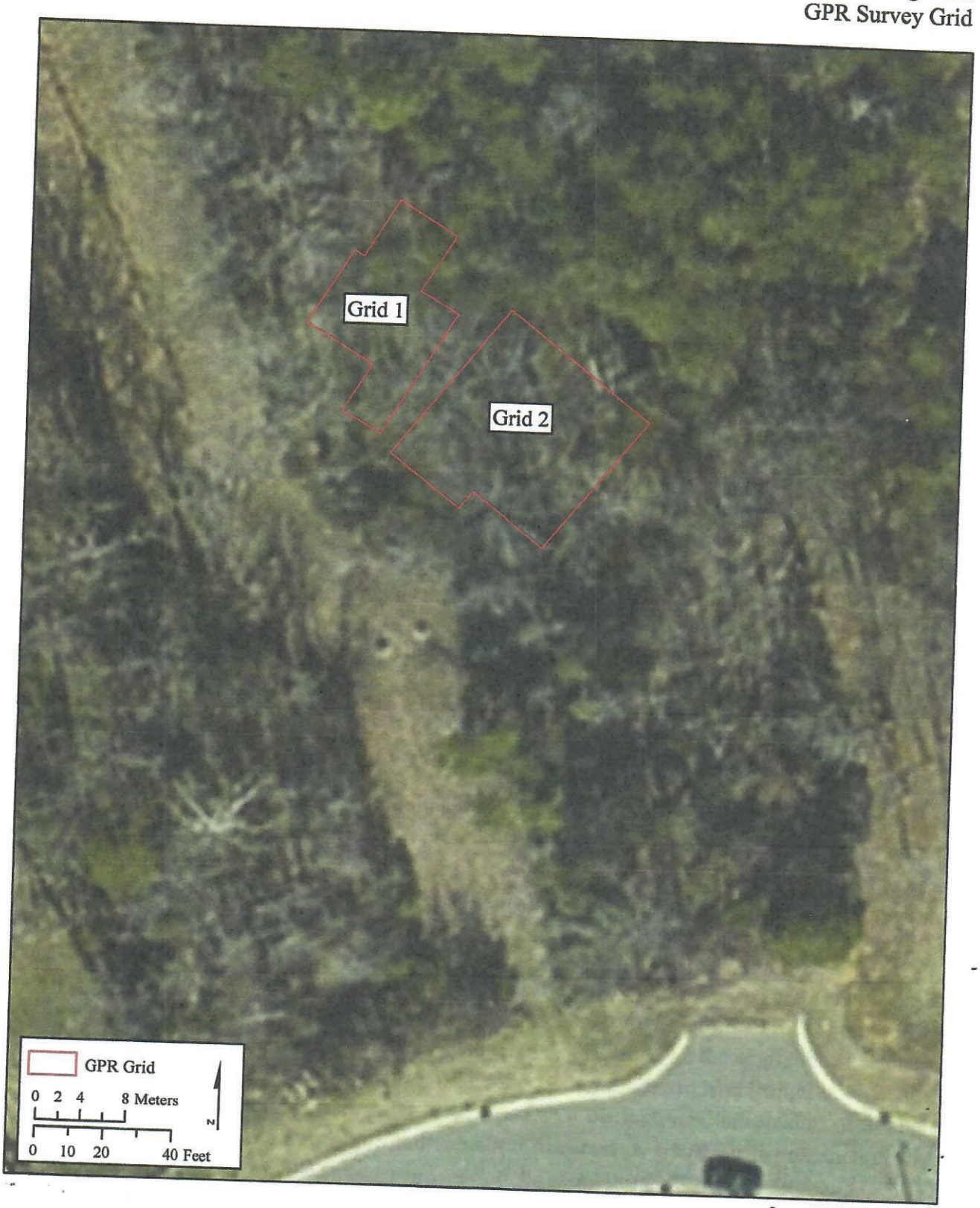
The first step was to calibrate the antenna to local conditions by walking the survey area and adjusting the instrument's gain settings. This method allows the user to get an average set of readings based on subtle changes in the RDP (Conyers 2004a). Field calibration was repeated as necessary to account for changes in soil and/or moisture conditions (Conyers 2004b). Effective depth penetration was approximately 2 meters (6.5 feet). This is excellent depth penetration for a 400 MHz antenna, very slight signal attenuation occurred at the bottom of the profile.

The field survey was conducted using a GSSI SIR-3000 using a 400 MHz antenna over the entire project area. The two grids covered the suspected cemetery where access to the ground was available (Table 1; Figure 2). The survey area was defined to cover the entire suspected cemetery area and as much of the areas around it as possible (approximately 0.1 ac.). It is generally standard practice to orient transects perpendicular to the long axis of suspected features. In this case, data were collected roughly northwest to southeast, as Christian burials are generally oriented east to west. Transect spacing was 50 centimeters, an interval that has been demonstrated to generate the best resolution possible (Pomfret 2005). Transects were collected in a zig-zag pattern, alternating starting direction, along the Y-axis (north-south).

Table 1. GPR Grids

Grid	Acres	Square Meters
Grid 1	0.06	253
Grid 2	0.04	142
Total	0.1	395

Figure 2.
GPR Survey Grid



Source: 2010 Microsoft Imagery

DATA PROCESSING

All data were downloaded from the control unit to a laptop computer for post-processing. Radar signals are initially recorded by their strength and the elapsed time between their transmission and receipt by the antenna. Therefore, the first task in the data processing was to set "time zero", which tells the software where in the profile the true ground surface was. This is critical to getting accurate results when elapsed time is converted to target depth. A background filter was applied to the data, which removes the horizontal banding that can result from antenna energy "ringing" and outside frequencies such as cell phones and radio towers. Background noise can make it difficult to visually interpret reflections. Hyperbolic reflections are generated from the way the radar energy reflects off point targets. In cemeteries, graves are often visible as hyperbolic reflections.

The next data processing step involved the generation of amplitude slice-maps (Conyers 2004a). Amplitude slice-maps are a three-dimensional tool for viewing differences in reflected amplitudes across a given surface at various depths. Reflected radar amplitudes are of interest because they measure the degree of physical and chemical differences in the buried materials. Strong, or high amplitude reflections often indicate denser (or different) buried materials. Such reflections can be generated at pockets of air, such as within collapsed graves, or from slumping sediments. Amplitude slice-maps are generated through comparison of reflected amplitudes between the reflections recorded in vertical profiles. Amplitude variations, recorded as digital values, are analyzed at each location in a grid of many profiles where there is a reflection recorded. The amplitudes of all reflection traces are compared to the amplitudes of all nearby traces along each profile. This database can then be "sliced" horizontally and displayed to show the variation in reflection amplitudes at a sequence of depths in the ground. The result is a map that shows amplitudes in plan view, but also with depth.

Slicing of the data was done using the mapping program *Surfer 8*. Slice maps are a series of x,y,z values, with x (east) and y (north) representing the horizontal location on the surface within each grid and z representing the amplitude of the reflected waves. All data were interpolated using the Inverse Distance Weighted method and then image maps were generated from the resulting files.

From the original .dzt files (raw reflection data), a series of image files was created for cross-referencing to the amplitude slice maps that were produced. Two-dimensional reflection profiles were also analyzed to determine the nature of the features identified on the amplitude slice maps. The reflection profiles show the geometry of the reflections, which can lend insight into whether the radar energy is reflecting from a flat layer (seen as a distinct band on profile) or a single object (seen as a hyperbola in profile). Individual profile analysis was used in conjunction with amplitude slice maps to provide stronger interpretations about possible graves.

The final step in the data processing is to integrate the depth slices with other spatial data. This was done using ArcGIS 10, which can display and manipulate all forms of spatial data created for this project, including GPR results, GPS data, and base graphics such as aerial photography and topographic maps. The resulting anomalies were digitized as individual features and referenced to the arbitrary coordinate system.

GPR IN CEMETERIES

Most Judeo-Christian cemeteries share common characteristics with respect to burial of the dead. In general, bodies are oriented east-west, with the head facing east to face the rising sun on Judgment Day. Depths vary, but are typically between two and six feet, depending on local conditions and customs. Shapes tend to oblong and rectangular to accommodate the use of coffins and caskets and burial in prone positions. Sizes can vary considerably, particularly between adults and infants, with most adults in the range of approximately six feet long and two feet wide (Patch 2009).

Several factors influence the overall effectiveness of GPR for detecting anomalies consistent with individual graves. Contrast between the remains, grave shaft, coffin, or casket and the surrounding soils is the most important variable. Remains that have a chemical or physical contrast from the subsurface materials surrounding them will cause reflections of electromagnetic energy. Age of the graves is critical to this contrast, with older graves typically have less contrast and are more difficult to detect because they have had more time to decompose and are less likely to have intact coffins or caskets (if these were present to begin with).

The burial "container" that the physical remains may have been placed in is also important and includes simple linen or cloth shrouds, pine boxes or wooden coffins, lead or other metal caskets, and burial vaults. In certain cases, hardware such as nails, hinges, and handles may be present, but not necessarily all the time. Although there is a high degree of variation in specific container types among different geographical regions, each of these tends to have been used at certain times throughout history and correlates with the presumed age of the grave. For example, burial shrouds were common throughout the seventeenth and early eighteenth centuries before being replaced by wooden coffins. It must also be noted that cultural trends and patterns tended to persist much longer in rural and/or economically depressed areas than in urban centers.

III. RESULTS AND RECOMENDATIONS

The primary purpose of this survey was to identify geophysical anomalies consistent with the expected signature for burials in order to identify the cemetery boundary. GPR results were based on analysis of the 400MHz data, including individual reflection profiles and amplitude slice maps. The burials themselves represent a relatively weak contrast with their surrounding soils, probably due to their age and burial conditions. They were, however, identifiable in plan and profile view (Figures 3-8).

Fourteen probable burials were identified; none are associated with markers and most of those probable burials were clustered near the depressions. All 14 of the burials are within the suspected cemetery, and none are at the edges of the GPR grids (Table 2; Figure 9).

Table 2. Summary of Probable Graves, with UTM Center Point Locations

ID	UTM North	UTM East
1	3987745.38095	635813.35052
2	3987738.86776	635822.34117
3	3987743.49896	635821.34652
4	3987741.91347	635823.34754
5	3987740.77697	635821.77047
6	3987749.74897	635824.99792
7	3987744.96032	635823.61127
8	3987746.31016	635821.79408
9	3987743.87152	635824.52905
10	3987745.86966	635820.09847
11	3987750.86621	635819.83926
12	3987746.54233	635813.35880
13	3987758.48701	635810.99290
14	3987755.38390	635809.89114

New South Associates takes a conservative approach to the identification of graves based on GPR data. The probable graves in the APE were identified based on their size, shape, depth, orientation, and overall reflective characteristics in both plan and profile. Many factors influence the overall effectiveness of GPR for detecting anomalies consistent with graves including soil type and acidity, moisture and precipitation, age of probable graves, likely burial depth, and burial container (e.g., shroud, wood coffin, metal casket, concrete vault). In general, if the anomaly has any of the characteristics of a burial it is marked as a potential burial.

Figure 3.
Profile Examples from the Browns Summit United Methodist Church Cemetery

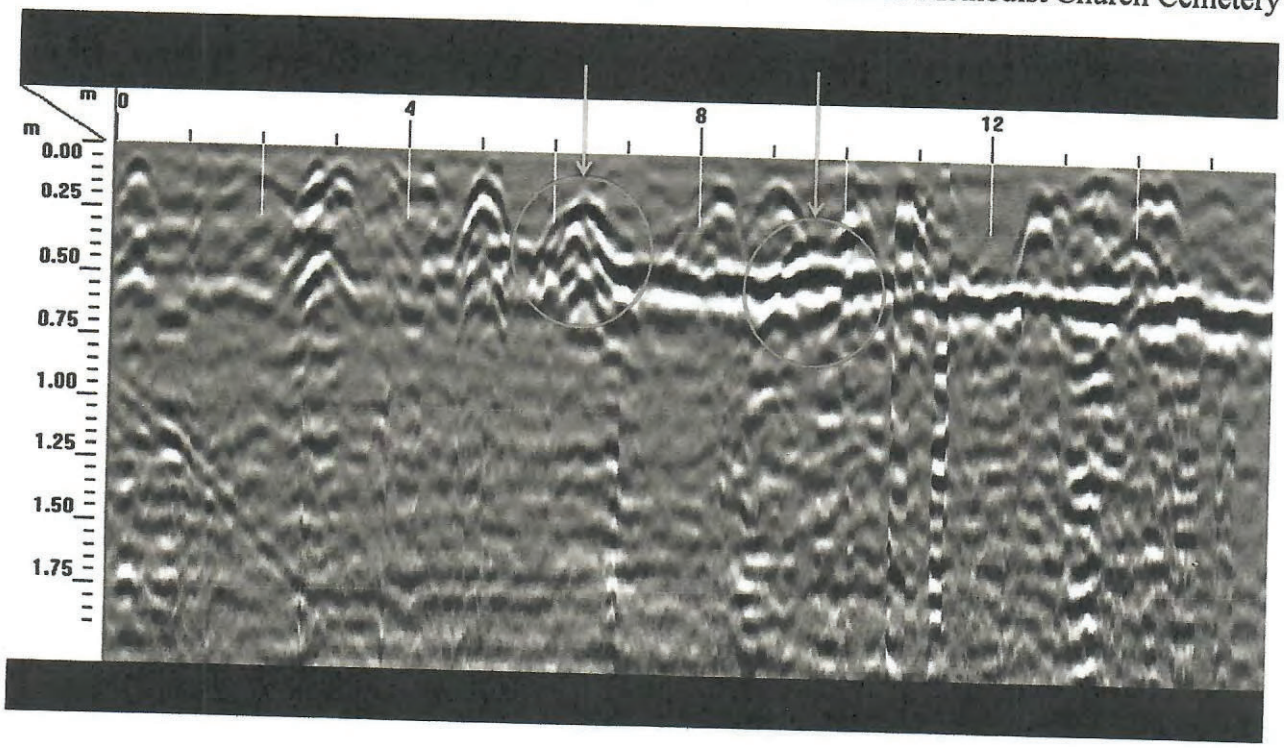


Figure 4.
Amplitude Slice Map from 0-30 Centimeters Below Surface (cmbs)

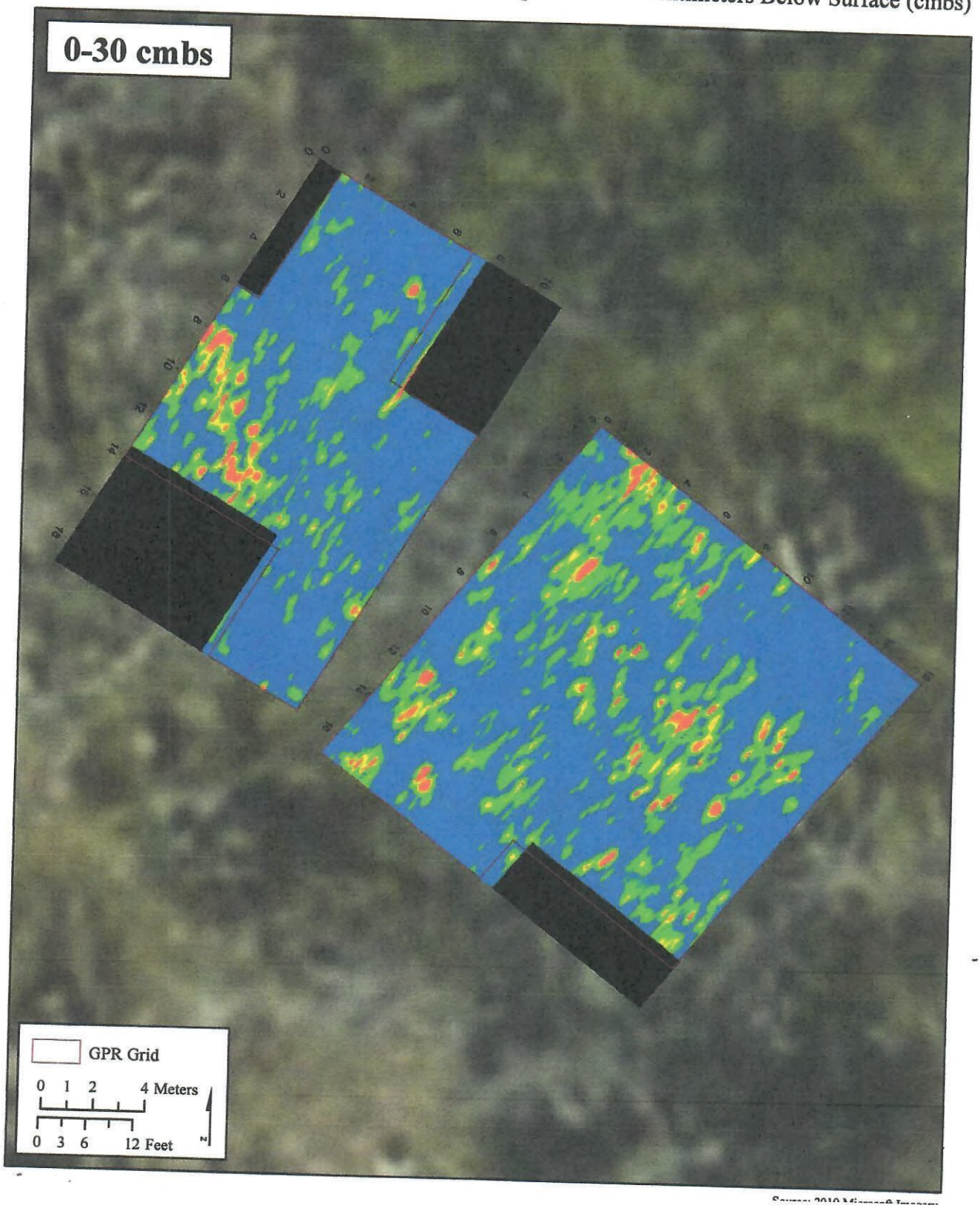


Figure 5.
Amplitude Slice Map from 30-60 cmbs

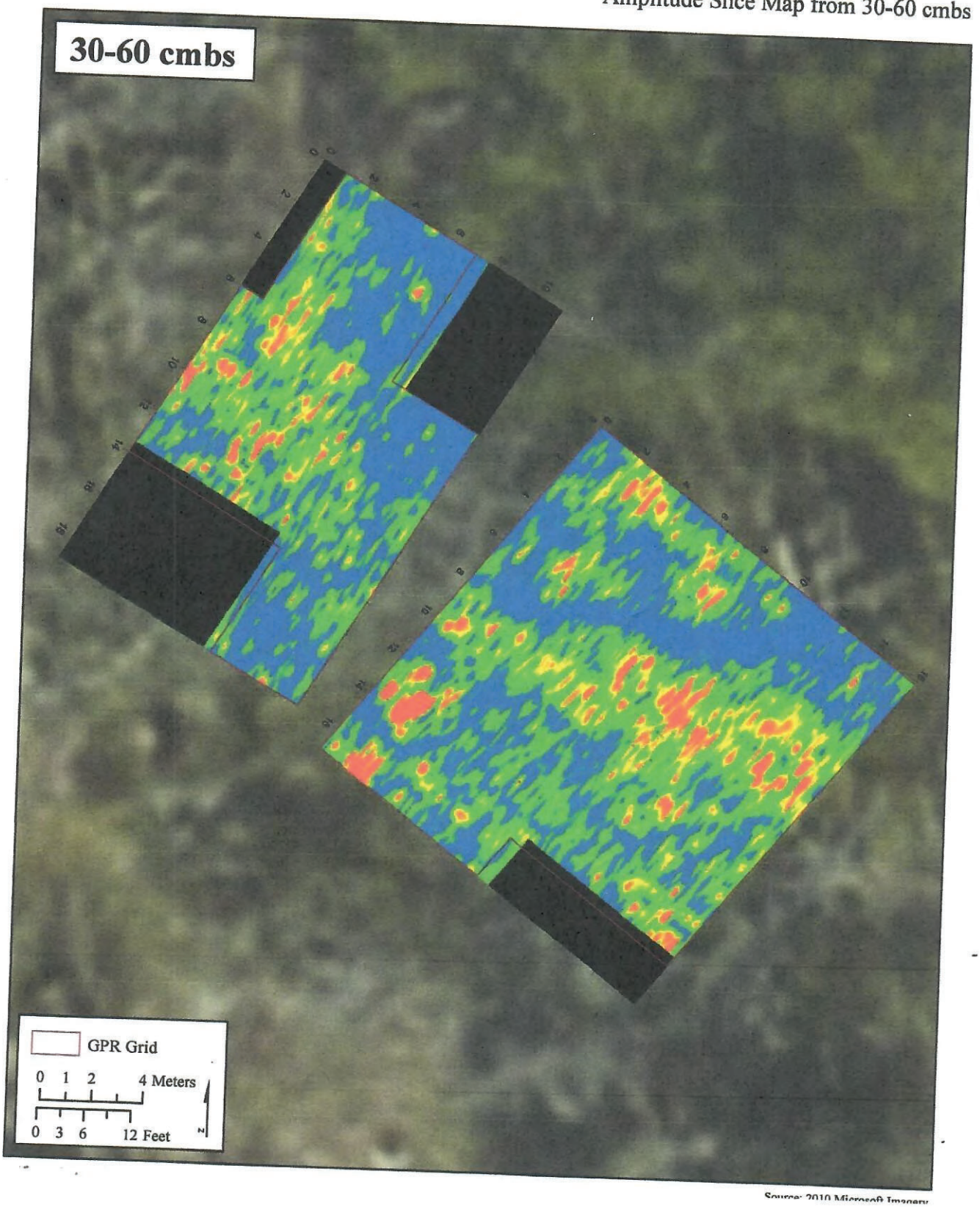


Figure 6.
Amplitude Slice Map from 60-90 cmbs

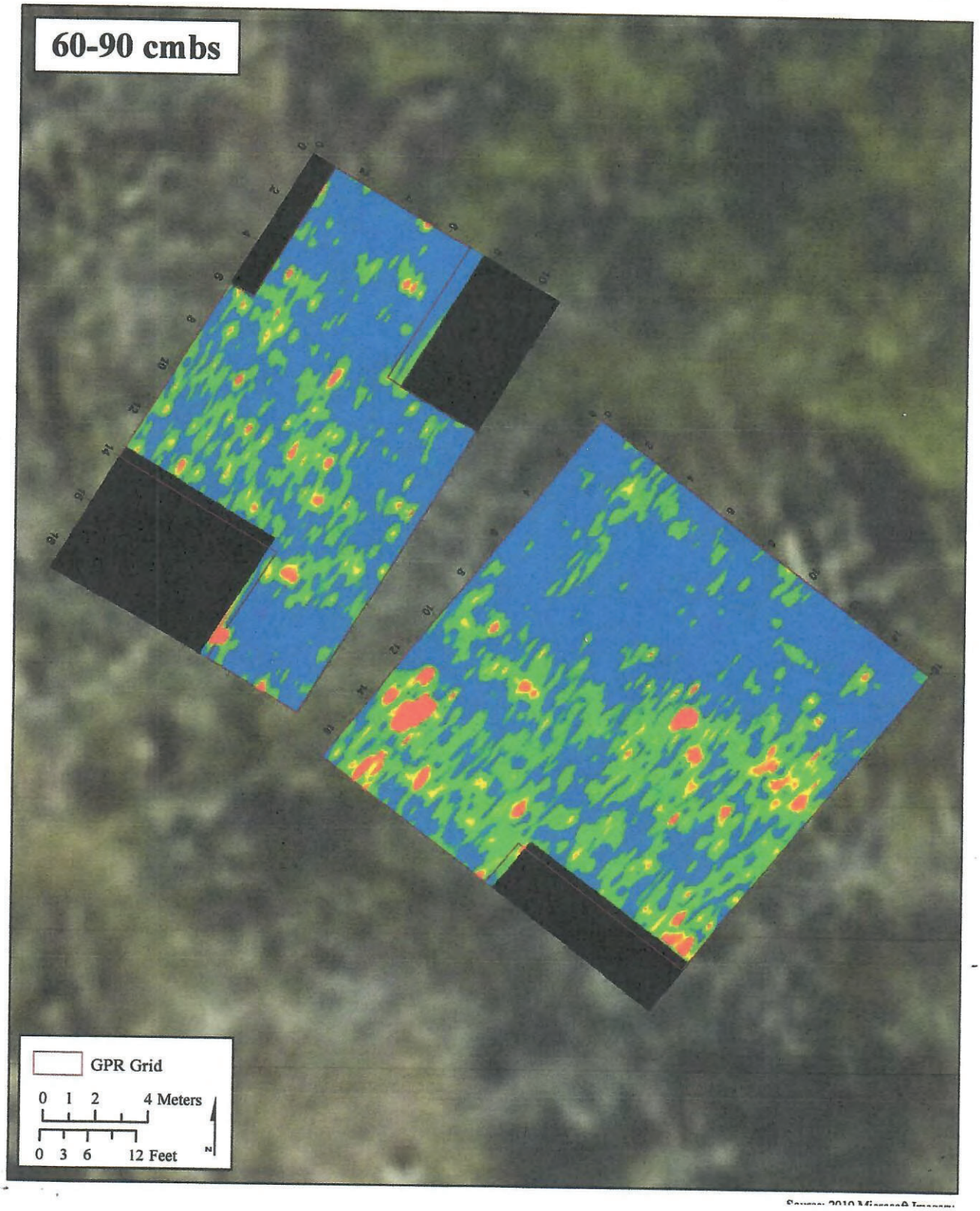


Figure 7.
Amplitude Slice Map from 90-120 cmbs

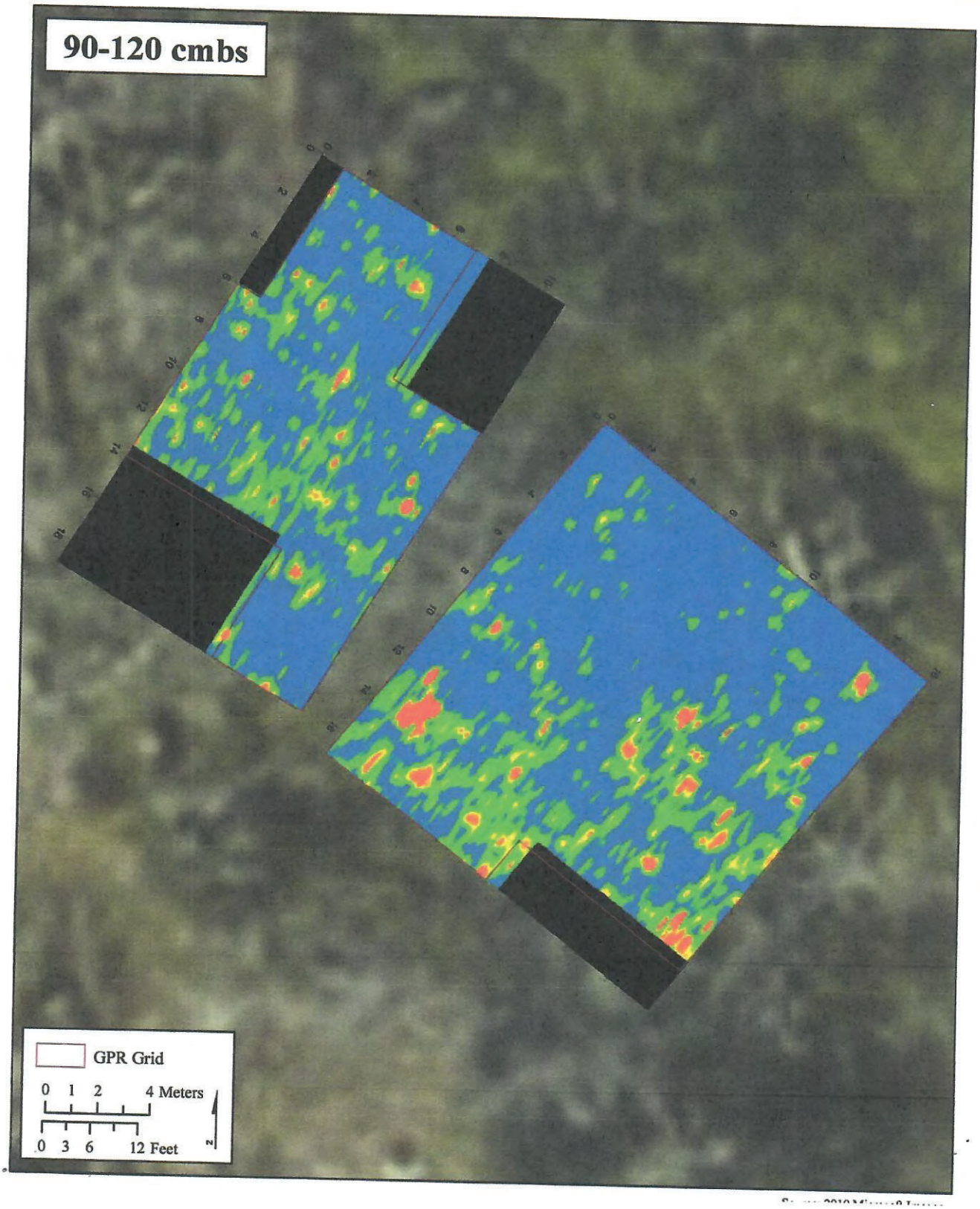
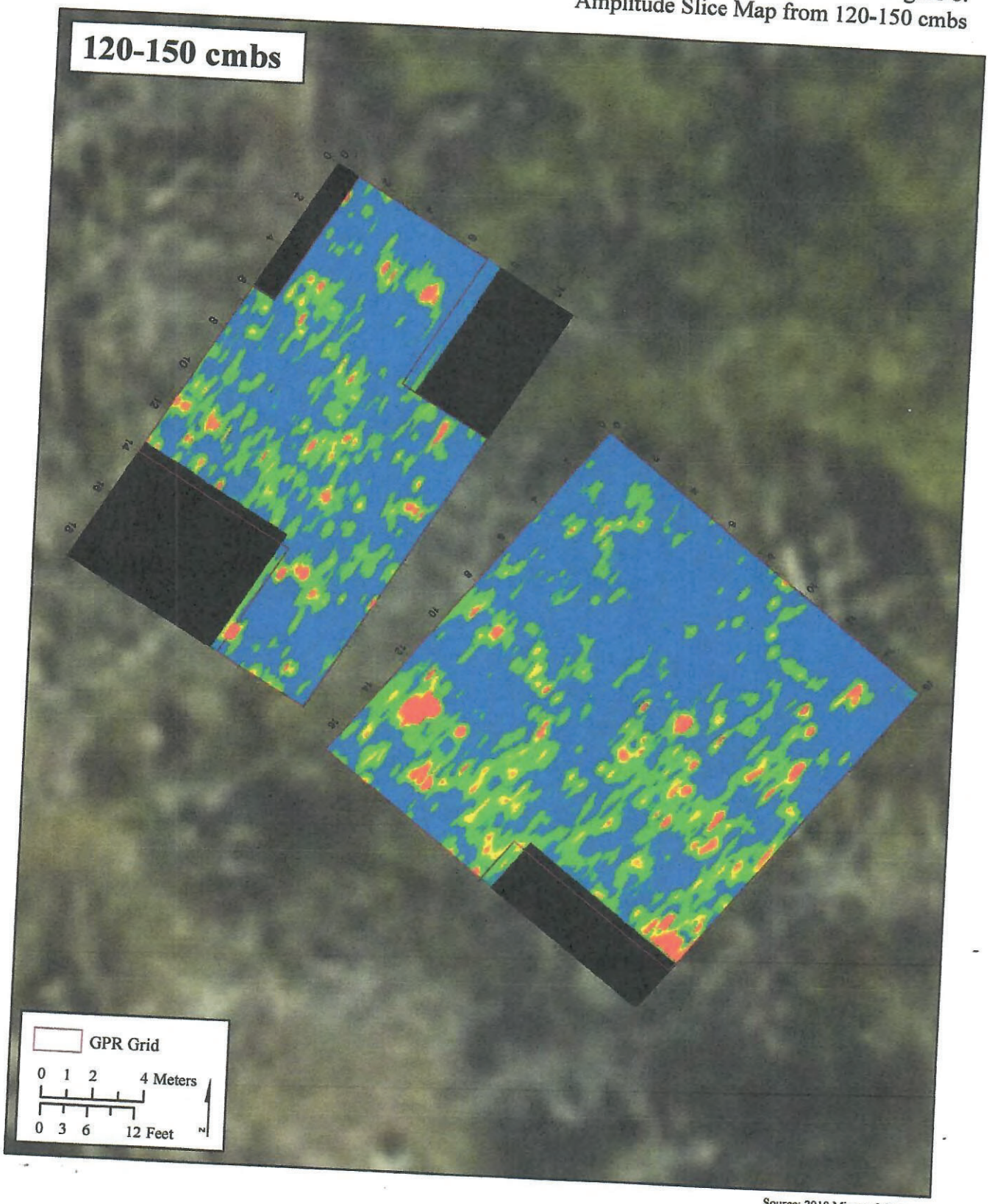
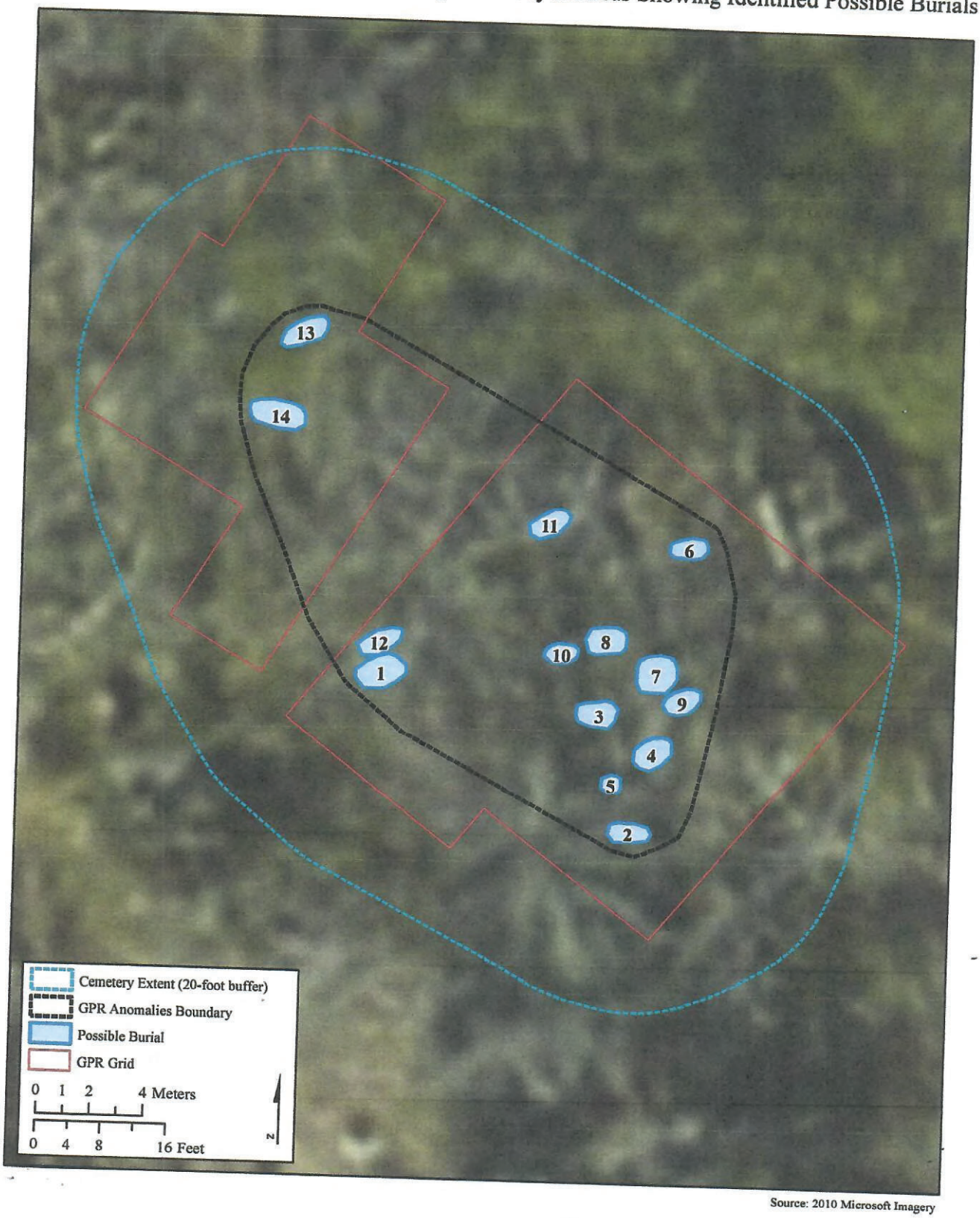


Figure 8.
Amplitude Slice Map from 120-150 cmbs



Source: 2010 Microsoft Imagery

Figure 9.
Map of Surveyed Areas Showing Identified Possible Burials



Source: 2010 Microsoft Imagery

New South Associates recommends that the 14 GPR anomalies identified as probable graves should be treated as such. They should be avoided by proposed construction impacts. Because these anomalies were not strong and the suspected cemetery is thought to date to the nineteenth century, which would make graves difficult to identify, a 20-foot buffer is recommended around the anomalies. While there are no specific statutory requirements for a buffer around cemeteries, New South Associates recommends the use of a buffer to avoid impacts to burials on the edges of a cemetery that may not have been detected; these include the graves of infants and children. In our experience, especially with older graves, a 20-foot buffer provides extra consideration and protection for graves that may be difficult to detect with any remote method. If the buffer size is reduced, the project sponsor must do this at their own risk. If this area cannot be avoided, provisions will need to be made for disinterment and reburial outside the APE and compliance with North Carolina General Statutes Chapter 65, Article 12, Sections 85-113, Abandoned and Neglected Cemeteries. In addition, the cemetery should be recorded formally with the Alamance County Courthouse so there is a record of its identification. Caution should be exercised around all probable graves. Although remote, there is still the possibility for additional graves that were not detected by GPR outside of the buffer. This is considered extremely unlikely due to both the survey results, extent of cemetery plantings, and location of the drainage.

REFERENCES CITED

Camp, Wallace J.

1965 *Soil Survey, York County, South Carolina*. 1961 17. United States Department of Agriculture, Washington D.C.

Conyers, Lawrence

2004a *Ground-Penetrating Radar for Archaeology*. AltaMira Press, Walnut Creek CA.

2004b Moisture and Soil Differences as Related to the Spatial Accuracy of GPR Amplitude Slice Maps at Two Archaeological Sites. June 21, Tenth International Conference on Ground Penetrating Radar, Delft, The Netherlands.

2012 *Interpreting Ground-Penetrating Radar for Archaeology*. Left Coast Press, Walnut Creek, California.

Conyers, Lawrence, and Jeffery Lucius

1996 Velocity Analysis in Archaeological Ground Penetrating Radar Studies. *Archaeological Prospection* 3(1): 25–38.

Jones, Geoffrey

2008 Geophysical Mapping of Historic Cemeteries presented at the Conference on Historical and Underwater Archaeology, Albuquerque, New Mexico.

Kaster, Dwight

1960 *Soil Survey of Alamance County, North Carolina*. United States Department of Agriculture Soil Conservation Service, Washingthon, D.C.

King, Julia A., Bruce W. Bevan, and Robert J. Hurry

1993 The Reliability of Geophysical Surveys in Historic-Period Cemeteries: An Example from the Plains Cemetery, Mechanicsville, Maryland. *Historical - Archaeology* 27(3): 4–16.

Patch, Shawn M.

2009 *Ground Penetrating Radar Investigations at the Christiansted Public Cemetery, St. Croix, United States Virgin Islands*Unpublished CRM. New South Associates, Inc., Stone Mountain, Georgia.

Pomfret, James E.

2005 *Ground Penetrating Radar Survey at Andersonville National Historic Site.* Georgia Department of Transportation, Atlanta, Georgia.